



()

n-

*

n-3

: _____

n-

(Flaxseed Oil)

(Oncorhynchus mykiss)

n-

/ ± /

: _____

±

/

/ - /

n-

: _____

(P < /)

.(P < /)

: _____

n-

: _____

// :

// :

() DHA

.()

ALA

.() DHA EPA :

EPA DHA n (DHA)

n (ALA) (EPA)

n

) EPA DHA

.(EPA DHA

.()

EPA DHA n

n ()

.() ()

.() n

n

n

EPA n n

.() DHA

()

(n-6) ALA

(n) EPA

ALA

.() EPA DHA

¹ Decosa Hexanoic acid

² Ecosa pentanoic acid

³ Alpha linolenic acid

/ /

. / - / pH

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.

.

(Dyer Bligh)

()

.(Rotary Evaporator)

/ /

(Gas chromatography) GC

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GC

SAS

(SAS Inst., Cary, 1989)

()

(HSD)

Mstat-C (P< /)

(MSTATC Director., Michigan, USA, 1980)

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.

.

(P> /)

[illegible]

/

/

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n

.

.

PUFA

ALA

.()

HUFA

.()

EPA

n

n

.(P< /)

, n

.()

.

.

()

.

)

(Drew)

(

(Chena)

()

()

(tocopherol)

EPA DHA

.()

n

(Tompson)

n

.()

ALA

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References:

1. Uauy-Dagach R, Valenzuela A. Marine oils as a source of omega-3 fatty acids in the diet: how to optimize the health benefits. *Prog Food Nutr Sci* 1992;16: 199-243.
2. Simopoulos AP. The importance of the ratio of omega-6/omega-3 essential fatty acids. *Biomed Pharmacother* 2002; 56:365-79.
3. Ackman RG. concerns for utilization of marine lipids and oils. *Food Technol* 1988; 42: 151-5.
4. Leaf A, Xiao YF, Kang JX, Billman GE. Prevention of sudden cardiac death by n-3 polyunsaturated fatty acids. *Pharmacol Ther* 2003;98:355-77.
5. Torrejon C, Jung UJ, Deckelbaum RJ. n-3 Fatty acids and cardiovascular disease: actions and molecular mechanisms. *Prostaglandins leukot Essent Fatty Acids* 2007;77:319-26.
6. Wainwright PE. Dietary essential fatty acids and brain function: a developmental perspective on mechanisms. *Proc Nutr Soc* 2002; 61:61-9.
7. Kankaanpaa P, Sutas Y, Salminen S, et al. Dietary fatty acids and allergy. *Ann Med* 1999;31:282-7.
8. Cornor WE. α -Linolenic acid in health and disease. *Am J Clin Nutr* 1999; 69: 827- 8.
9. Gerster H. Can adults adequately convert alpha-linolenic acid (18:3n-3) to eicosapentaenoic acid (20:5n-3) and docosahexaenoic acid (22:6n-3)? *Int J Vitam Nutr Res* 1998; 68:159-73.
10. Gibson RA, Makrides M, Neumann MA, et al. Ratios of linoleic acid to alpha-linolenic acid in formulas for term infants. *J Pediatr* 1994;125:S48-55.
11. Berry EM. Dietary fatty acids in the management of diabetes mellitus. *Am J Clin Nutr* 1997;66 (Suppl 4): 991-7.
12. Sirtori CR, Galli C. N-3 fatty acids and diabetes. *Biomed Pharmacother* 2002; 56: 397-406.
13. Kinsellen JE. Fish and sea foods: Nutritional implication and quality issues. *Ann Food Technol* 1988 ;1 : 16-9.
14. Castel JD, Lee DJ, Sinnhuber RO. Essential fatty acids in the diet of rainbow trout (*Salmo gairdneri*): lipid metabolism and fatty acid composition . *J Nutr* 1972; 102 : 93-9.
15. Goddard S. Feed Types and Uses. Feed managment in intensive aquaculture. 5th ed. USA: Chapman and Hall ,1996, 80-145.
16. Cunnane SC, Ganguli S, Menard C, et al. High alpha-linolenic acid flaxseed (*Linum usitatissimum*): some nutritional properties in humans. *Br J Nutr* 1993;69:443-53.
17. Hutchins AM, Martini MC, Olson BA, et al. Flaxseed consumption influences endogenous hormone concentrations in postmenopausal women. *Nutr Cancer* 2001;39:58-65.
18. Association Of Official Analytic Chemist Ins. Official Methods Of Analysis. 15th ed. USA, Arlington: The Institute; 1990,1015.
19. Pike RL, Brown ML. Nutrition: An Integrated Approach. 2nd ed. New York: John Wiley and Sons, 1967, 542.
20. Bligh EG, Dyer WJ. Rapid method of total lipid extraction and purification. *Can J Biochem Physiol* 1959; 37: 912-7.
21. Menoyo D, Lopez-Bote CJ, Bautista JM, et al. Growth, digestibility and fatty acid utilization in large Atlantic salmon (*Salmo salar*) fed varying levels of n-3 and saturated fatty acids. *Aquaculture* 2003;225: 295-307.
22. Kaushik SJ, Oliva-Teles A. Effect of digestible energy on nitrogen and energy balance in rainbow trout. *Aquaculture* 1989 ; 50: 89-101.
23. Luzzana U, Serrini G, Moretti VM, et al. Effect of expanded feed with high fish oil content on growth and fatty acid composition of rainbow trout. *Aquac Int* 1994; 2: 239-48.
24. Drew MD, Ogunkoya AE, Janz DM, et al. Dietary influence of replacing fish meal and

-
- oil with canola protein concentrate and vegetable oils on growth performance, fatty acid composition and organochlorine residues in rainbow trout (*Oncorhynchus mykiss*). *Aquaculture* 2007; 267:260-8.
25. Chena YC, Nguyen J, Semmens K, et al. Physicochemical changes in ω – 3-enhanced farmed rainbow trout (*Oncorhynchus mykiss*) muscle during refrigerated storage. *Food Chem* 2007; 104: 1143-52.
26. Tompson KD, Tatner MF, Henderson RJ. Effects of dietary (n- 3) and (n-6) poly unsaturated fatty acid ratio on the immune of atlantic salmon, *salmo salar* L. *Aquaculture Nutr* 1996;2: 21-31.
27. Hardy RW. Aquaculture's rapid growth requirements for alternate protein sources. *Food Manage* 1999; 50:25-8.